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Taiwan Fire Codes for Wood Frame Construction Update

Report Categories:

Solid Wood Products

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Report Highlights:

This GAIN report is a follow up to GAIN TW8066 which detailed the October 2008 announcement by the Taiwan authority of its Fire Codes for Wood Frame Construction. After many years of discussions and consultations, the Taiwan Construction and Planning Agency Ministry of Interior (CPAMI) finally announced a building code chapter containing Fire Codes for Wood Frame Construction on October 31, 2008. These new codes should greatly increase opportunities for numerous new wood product applications in Taiwan. The attached report includes the original version of the regulations in Chinese and an English version prepared by American Forest and Paper Association and APA-The Engineered Wood Association

General Information:

1. English Version

Chapter 9 Fire Protection of Building Construction

9.1 General

Except for the provisions as specified in Chapter 3 of Building Technical Specification, design and construction of fire resistance of wood construction buildings shall comply with the requirements as specified in this Chapter.

Fire resistant methods (or fire resistant design) beyond what are specified in this Chapter shall not be used until they are recognized by the construction agency of the central government.

(Commentary)

Due to the concern on public safety, it is regulated in the building codes and standards that buildings under specific use of occupancy and with specific total number of stories and sizes be fire resistant, which is specified in Clause 69 of Building Technical Specification. Except for Type C buildings, industrial buildings shall have the main structure constructed with non-combustible material if the floor area of workshop is more than 50 m². Buildings constructed with wood construction shall also conform to the requirement.

For the fire safety design of special building system, if the design requirements in current Building Technical Specification is not applicable, or there is no such requirements available in current Building Technical Specification or China National Standards (CNS), the application letter and the report of performance assessment shall be submitted to the construction agency of the central government in order to apply for the recognition in the category of New Technology, New Construction and New Material.

9.2 Basic Principles of Fire Resistant Design for Wood Construction Buildings

Design of unprotected wood construction buildings shall account for necessary fire protection based on the following requirements:

- (1) Fire compartmentation shall be layouted in accordance with pertinent requirements. Fire resistance rating of fire separation and fire partition shall comply with the pertinent requirements.
- (2) Interior finishes shall be constructed in accordance with pertinent requirements.
- (3) Exterior cladding and roofing material shall be non-combustible in principle.
- (4) Corridors, hallways and entrances shall be designed in accordance with the requirements on safety design of means of egress.
- (5) Fire separation between buildings shall be provided in order to prevent fire from spreading to adjacent buildings in case of fire.

For protected wood construction buildings, aside from the requirements as specified above, fire resistance rating of the main structural members such as columns, beams, loadbearing walls, floors and roofs shall conform to the pertinent requirements.

(Commentary)

Attention on fire protection shall be paid to the buildings constructed in accordance with the requirements as specified in Design and Construction Section of Building Technical Specification. The general purpose of the fire safety design of wood construction building is to reduce the casualty and loss of properties caused by fire. The basic principle of the fire safety design of wood construction buildings shall be as follows:

(A) Fire compartmentation shall be layouted in accordance with the following requirements:

- (1) Design of protected wood construction buildings shall comply with the requirements as specified in Clause 79, Design

and Construction Section of Building Technical Specification:

For buildings with total floor area exceeding 1,500 m², the area of each fire compartmentation shall be 1,500 m². Fire compartmentation shall be enclosed with at least one hour fire resistance rated walls, floors, fire rated doors and windows. The insulation performance of fire rated doors and windows shall be at least 1.0 hour.

For fire compartmentation equipped with automatic sprinkler system, the total floor area within the fire compartmentation will be allowed to increase 100%.

The firewalls shall be projected at least 50 cm beyond surface of exterior wall unless the exterior walls at the intersections are more than 90 cm in length and have the fire resistance rating not less than that of firewalls.

For buildings enveloped with curtain wall system, construction details on intersection between firewalls and exterior walls shall be in compliance with the requirements as specified above.

(2) Unprotected wood construction buildings shall be constructed in accordance with the requirements as specified in Clause 81, Design and Construction Section of Building Technical Specification, which are: the total floor area shall be divided into the fire compartmentation with the area limited to 500 m² and enclosed with at least 1.0 hour fire resistance rated walls.

Wood construction row houses are unprotected wood construction buildings and shall be constructed in accordance with the requirements as specified in Clause 84, Design and Construction Section of Building Technical Specification, which are: buildings with area more than 300 m² and constructed with trusses fabricated with combustible material such as wood shall be divided by 1.0 hour fire resistance rated walls. Walls shall be projected at least 50 cm beyond surface of exterior wall unless the exterior walls at the intersections are more than 90 cm in length and have the fire resistance rating not less than that of fire rated walls.

(B) Use of interior finishes within wood construction buildings shall comply with the requirements as specified in Clause 88, Design and Construction Section of Building Technical Specification.

(C) Unprotected wood construction buildings shall be constructed in accordance with the requirements as specified in Point 1 of Clause 84, Design and Construction Section of Building Technical Specification and have exterior walls and roofs constructed or enveloped with non-combustible material unless construction of buildings comply with the requirements as specified in Item 2, Point 1 of Clause 110, Design and Construction Section of Building Technical Specification.

(D) Corridors, hallways and entrances shall be designed in accordance with the requirements on the design of entrance, corridors and staircase which are specified in Section 1 of Design and Construction Section of Building Technical Specification.

(E) Design of fire separation shall comply with the following requirements:

(1) For protected wood construction buildings, fire separation shall comply with the requirements as specified in Clause 110, Design and Construction Section of Building Technical Specification.

(2) For unprotected wood construction buildings, fire separation shall comply with the requirements as specified in Point 1 of Clause 110, Design and Construction Section of Building Technical Specification.

(F) For protected wood construction buildings, the fire resistance rating of columns, beams, bearing walls, floors and roof shall comply with the requirements as specified in Clause 70, Design and Construction Section of Building Technical Specification.

9.3 Fire Safety Design of Wood Construction Buildings

(1) Post and Beam Structure

(a) The minimum section size shall be determined based on the required fire resistance

rating. The size of remaining wood section shall comply with the minimum requirements as needed based on strength capacity.

(b) The thickness of char layer of glulam members manufactured with different species shall comply with the values as specified in Table 9.3-1. However, the thickness of char layer which are recognized by the authorized agency of the central government shall be the one to dominate the fire safety design

(c) Metal connectors used in member connection shall be protected with appropriate fire resistant enveloping or hidden within the members with requested fire resistance rating in order to maintain the structural integrity of connections.

(2) Wood frame construction

(a) The size of framing material of wall, floor and roof assemblies shall comply with the minimum requirements based on engineered design.

(b) Fire-resistant sheathing and infill material shall be able to maintain the fire resistant performance during requested fire resistance period. Wall assemblies sheathed with 15 mm thick or above Class I fire resistant gypsum board or 12 mm thick or above silicon-calcium board on both sides, filled with 50mm thick or above mineral wool insulation material with density more than 60kg/m^3 may have 1.0 hour fire resistance rating.

(c) Joints between fire resistant boards shall be tightly closed during requested fire resistance period. Fire stops shall be installed behind joints in order to maintain the fire resistance capacity.

(d) Draftstops shall be installed at concealed spaces in wall, ceiling, floor and roof assemblies such that fire penetrated into one space will be prevented from spreading into another.

(3) Log House System

For log house system, the section size shall be determined based on consideration of charring effect which is applied in the fire safety design of post and beam structure. The design of connections shall also be in accordance with requirements as requested in the design of post and beam structure. Other than that, the design of the rest of structure shall be in accordance with pertinent codes and standards.

(4) Fire safety design of such structural systems as I- joist and trusses, shall be recognized by the construction agency of the central government.

(Commentary)

(A) Fire safety design of post and beam structure

For structural members such as columns, beams, studs and bracings, design of member sections shall account for thickness of char layer generated during requested fire resistance period if members are not covered with fire resistant material such that the strength capacity of the remaining wood section (safe section) can be maintained. The thickness of char layer is equal to assumed charring rate (the rate of char generated in case of fire) times fire period.

In Taiwan, 30 min and 60 min fire testing about charring effects of glulam members manufactured with five different species were conducted in accordance with 'Testing Method about Fire Resistance of Structural Members' (CNS12514). Testing results are tabulated in Table 9.3-1. It is suggested based on the testing results that, for glulam members manufactured with other species, the minimum designated thickness of char layer for 1.0 hour and 30 min fire resistance rated members shall be 50 mm and 25 mm, respectively. For non- glulam members, the minimum thickness of char layer for 1.0 hour and 30 min fire resistance rated members shall be 60 mm and 30 mm, respectively. Aside from these values as specified above, the testing values recognized by the agencies of the central government may also be used. Design method without accounting for charring effects needs to be recognized by the agency of the central government.

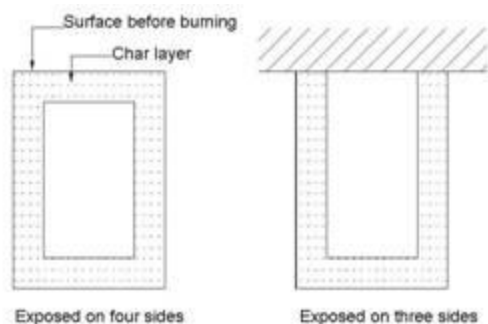


Fig. 9.3-1 Thickness of char layer



Fig. 9.3-2 Remaining wood section of three side exposed members after one fire

Table 9.3-1 Depth of char layer of glulam members manufactured with different species

Species		Time tested	Depth of char layer on sides	Depth of char layer on bottom side	Remark
Glulam members	Fir	30 min	20.0 mm	23.5 mm	1. Testing method conforming to CNS12514 - Testing Method about Fire Resistance of Structural Members. 2. Exposed on three sides. 3. Section size for 30 min test is 260 mm x 140 mm 4. Section size for 60min test is 260 mm x 203 mm
		60 min	43.4 mm	46.0 mm	
	Sigi	30 min	20.4 mm	21.5 mm	
		60 min	42.1 mm	46.8 mm	
	Taiwanese Fir	30 min	22.7 mm	23.5 mm	
		60 min	45.4 mm	49.0 mm	
	Douglas Fir	30 min	19.2 mm	20.8 mm	
		60 min	37.4 mm	37.9 mm	
	Southern Pine	30 min	17.0 mm	17.2 mm	
		60 min	32.8 mm	34.0 mm	
Non-glulam members	Other species	30 min	25mm		
		60 min	50mm		
		30 min	30mm		
		60 min	60mm		

Fire protection on metal connectors shall be considered in the design of connections in order to prevent the connectors from functionally failing due to the decreasing of strength capacity resulting from the continuous exposure in fire. Metal connectors shall be covered under fire resistant envelope with adequate thickness or hidden within unaffected portion of members during requested fire resistance period.

(B) Fire safety design of wood frame construction

Fire safety design of wood frame construction shall be in accordance with the following requirements:

- The minimum size of studs in 2x4 wood frame constructions shall be 38 mmx89 mm spaced at not more than 455 mm on centers.
- The minimum size of studs in 2x6 wood frame constructions shall be 38 mmx140 mm spaced at not more than 610mm on centers.
- The minimum thickness of fire resistant sheathing material shall be 15mm or 12mm for Class I fire resistant gypsum board (conforming to CNS4458) or Class I fire resistant silicon-calcium board (conforming to CNS13777), respectively.
- At least 50 mm thick mineral wool (conforming to CNS9659) with density more than 60kg/m³ may be used as the insulation material in wall cavities.
- Structural assemblies constructed in accordance with the requirements as specified above will be considered as being 1.0 hour fire resistance rated.
- In case of fire, joints between fire resistant boards will highly likely be the weak point in the design of fire safety. It is therefore that, in addition to the requirements on the sealing of joints, fire stops with adequate section size shall be installed under the joints such that fire will be prevented from spreading.

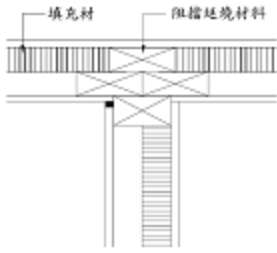


Fig. 9.3-3 Joints between fire resistant boards and fire stops underneath (1)



Fig. 9.3-4 Joints between fire resistant boards and fire stops underneath (2)

(g) As the space within the cavities of walls ceiling, floor and roof assemblies are enclosed by fire resistant boards and will likely become the path of fire spreading in case of the occurrence of fire penetration, the space shall be divided into several parts. Alternatively, draftstops may be installed at the intersections of structural assemblies such that fire won't spread into adjacent spaces or structural assemblies in case of the occurrence of fire penetration. Draftstops shall be fire resistant material with adequate section size.

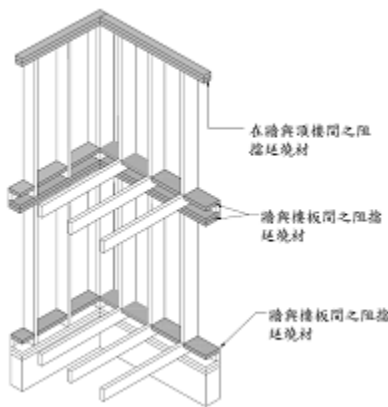


Fig. 9.3-5 Draft stops in wood frame construction (1)

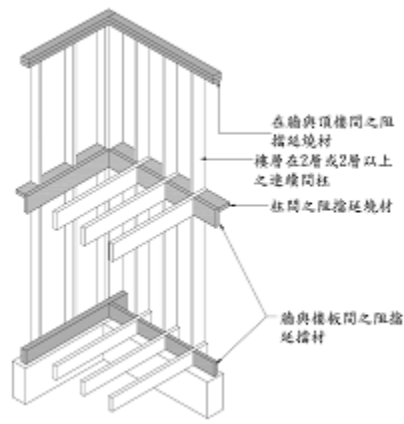


Fig. 9.3-6 Draft stops in wood frame construction (2)

(h) Commonly used wall, floor and roof assemblies in foreign countries are provided in Appendix 6, which shall be recognized by the agency of the central government when used in this country.

(C) Fire safety design of log house system

Log house system is the type of construction where wall system is constructed by stacking log, lumber or similar type of material horizontally.

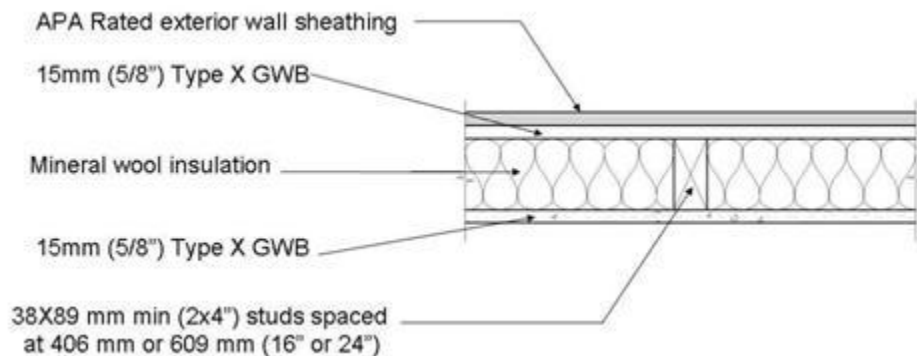
Fire safety design of structural members shall be the same as what are used in post and beam construction, i.e., the thickness of char layer generated during the requested fire resistance period shall be estimated and used to determine adequate section size such that the strength capacity of remaining wood section will be maintained. The long-term working stress of the remaining wood section shall be not more than the short-term working stress. The designated thickness of char layer for 1.0 hour fire resistance rated members shall be at least 60mm.

Appendix 6 Commonly Used Wood Frame Construction Wall, Floor and Roof Assemblies in Foreign Countries

Requirements on the construction of fire resistance rated wood frame construction wall, floor and roof assemblies are specified in Table 720.1(2) and 720.1(3) of Section 720, Chapter 7 of International Building Code (2006), published by International Code Council. These requirements need to be further studied before they are used domestically such that it'll be certain that they are in accordance with the regulations as specified in the national law. Design and construction based on these practices need to be recognized by the construction agency of the central government.

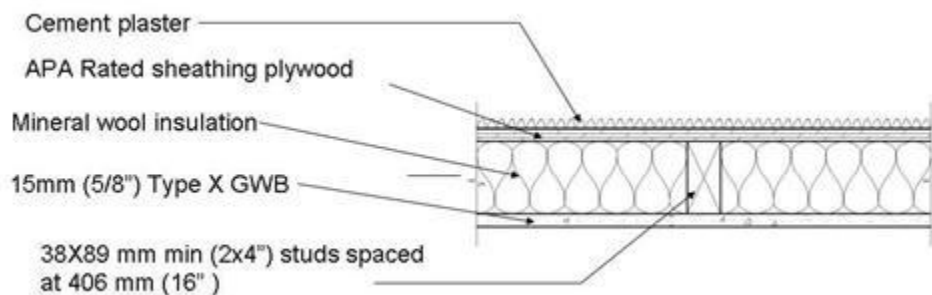
Fire resistance rated loadbearing wall, floor and ceiling assemblies, which are conform to the requirements as specified in APA's 'Fire Rated Systems - Design/Construction Guide' and pass through the verification test, are provided as follows. Use of these construction details still needs to be recognized by the construction agency of the central government.

Appendix 6-1 Construction of 1.0 hour fire resistance rated exterior loadbearing walls



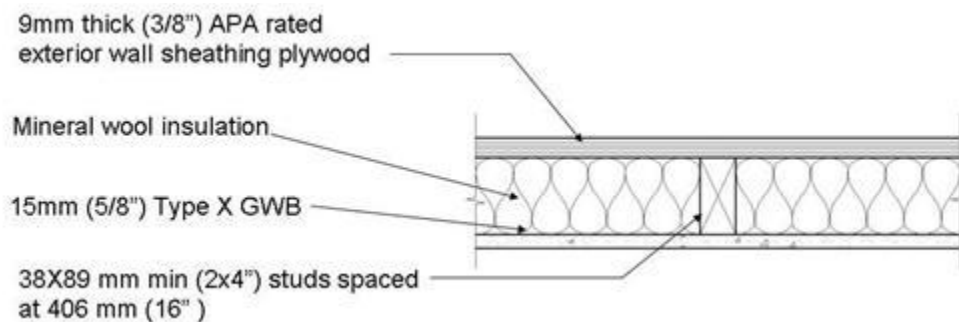
(a)

(Referenced from: Tab. No. 7-B of 1997 Union Building Code and Sec. 701.5.21999 of Standard Building Code)



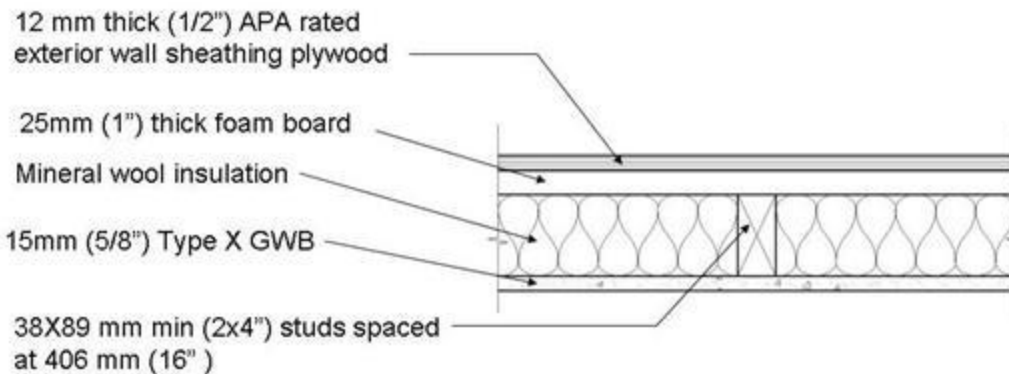
(b)

(Referenced from: Table 720.1(2) of 2003 International Building Code and Sec. 2.2.2 of ICC Evaluation Service Inc., Report No.ER-1952)



(c)

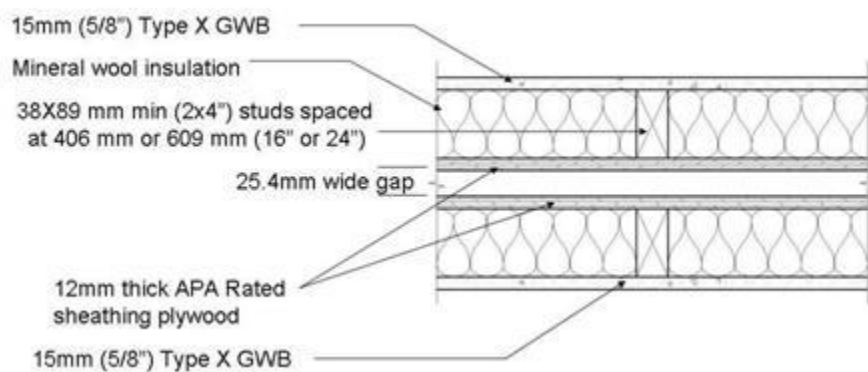
(Referenced from: Section 721-6 of International Residential Code, Section 709.6.2.4 of the International Building Code, Section 6.2 of Guidelines for Determining Fire Resistance Ratings of Building Elements (BOCA International, Inc./1994/))



(d)

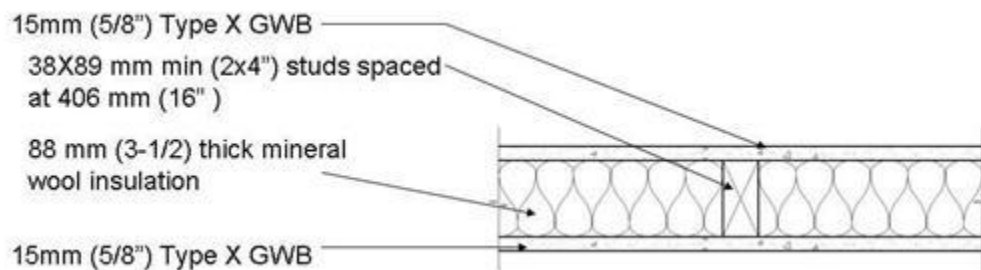
(Referenced from: UL design No. U326, U330 (see figure above) , U335 (see figure above) , Underwriters Laboratory Inc. (U.L.) Fire Resistance Directory)

Appendix 6-2 2 Construction of 1.0 hour fire resistance rated interior wall

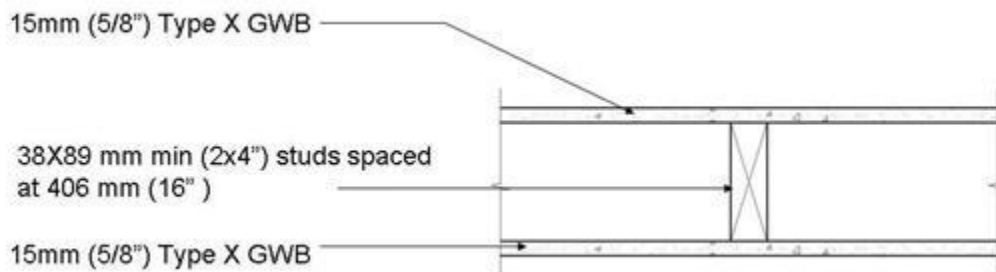


(a)

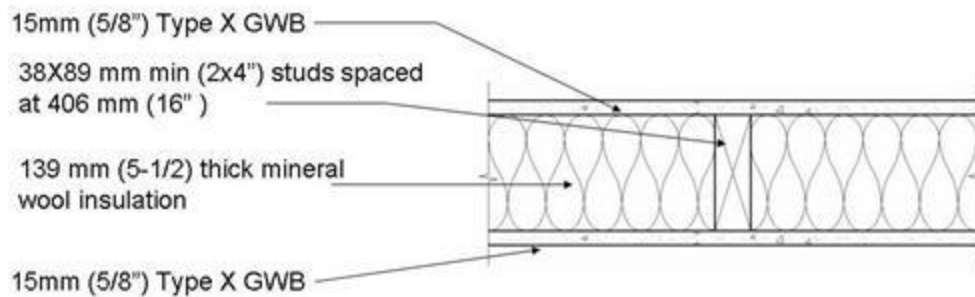
(Referenced from: UL design No. U339, U341, Underwriters Laboratory Inc. (U.L.) Fire Resistance Directory)



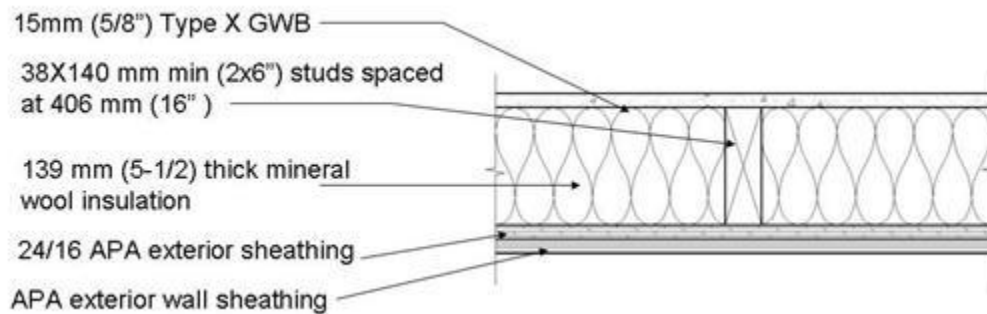
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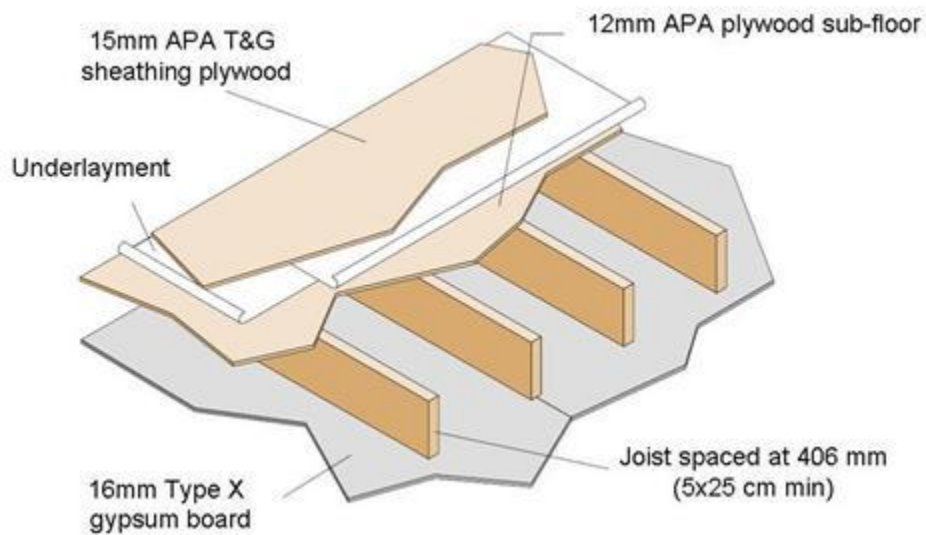


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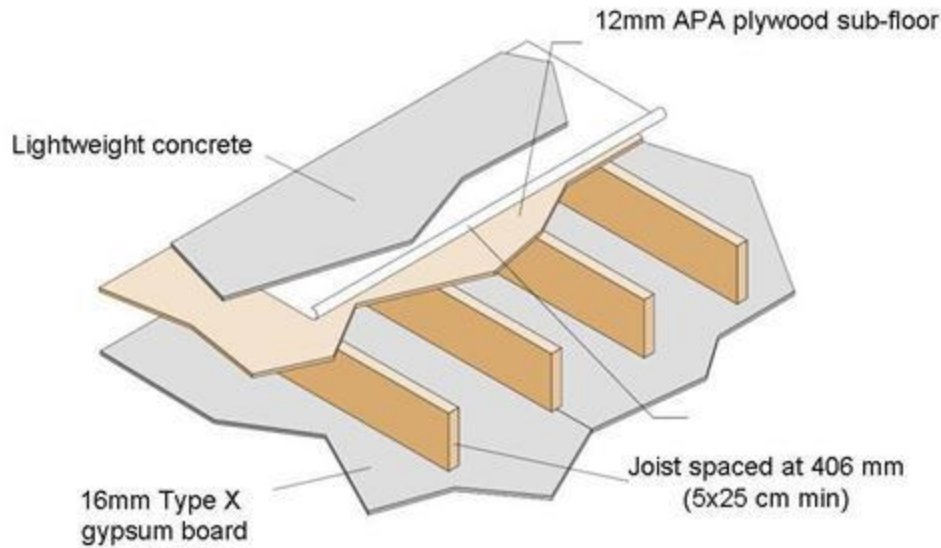


(e)

Appendix 6-3 Construction of 1.0 hour fire resistance rated floor and ceiling assemblies

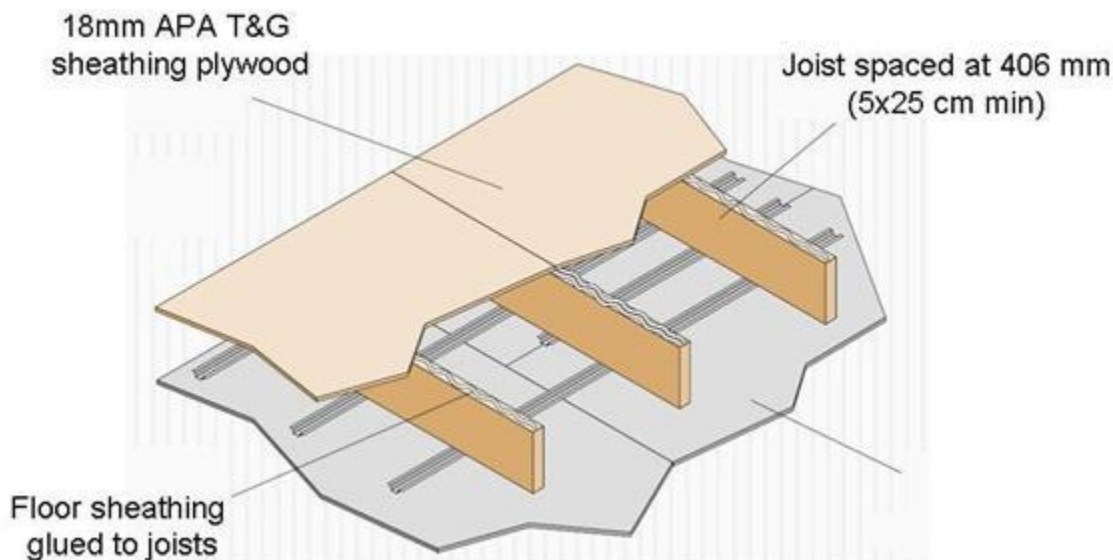


(a)



b)

(Referenced from: Underwriters Laboratory U.L. Design Nos. L001, L003, L004, L005, L006, L201, L202, L206, L209, L210, L211 (2 hr), L212, L501, L502, L503, L505 (2 hr), L511 (2 hr), L512, L514, L515, L516, L519, L522, L523, L525, L526, L533, L535, L536 (2 hr), L537, L541 (2 hr) and L545. Also see U.L. Design Nos. L524 with steel joists spaced 24" o.c., L521 with wood trusses spaced 24" o.c. and L549 with steel trusses spaced 48" o.c.)

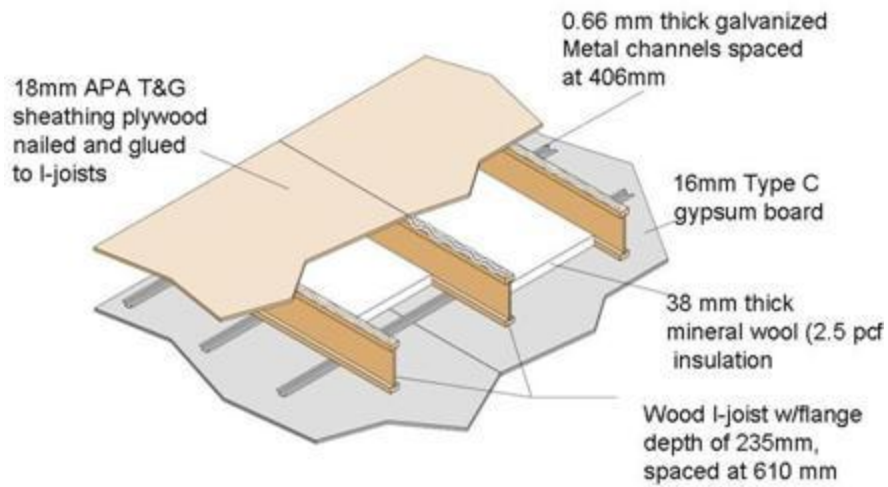


(c)

(Referenced from: Underwriters Laboratory U.L. Design No. L513. Also see U.L. Design Nos. L504 for stressed-skin panel (5/8" APA RATED STURD-I-FLOOR or SHEATHING plywood with joists spaced 12" o.c.); L507 for 5/8" APA RATED STURD-I-FLOOR plywood with joists spaced 16" o.c.; L508 for 1-1/8" APA RATED STURD-I-FLOOR plywood with joists spaced 48" o.c.; and L539, L540 with joists spaced 16" or 24" o.c. and separate ceiling assembly (for modular housing units). Also see U.L. Design Nos. L524 and L543 with steel joists spaced 19.2" or 24" o.c. (L543 with separate ceiling assembly)

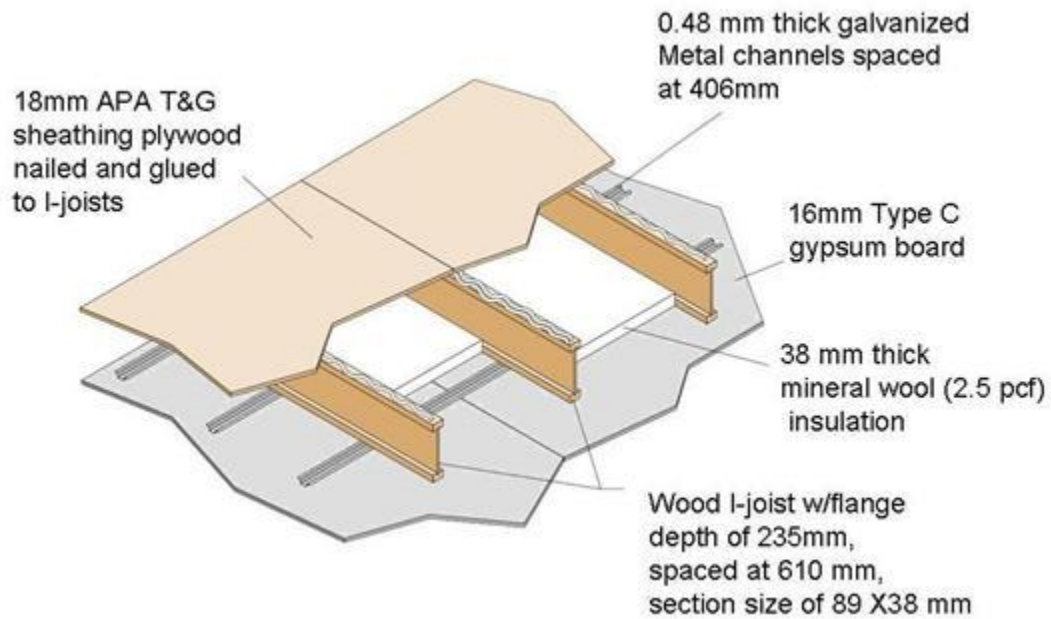
Single layer I-joist or floor truss system

(Referenced from : U.L. Design Nos. L528, L529, L534, L542 and L548 with trusses or L544 with I-joists spaced 24" o.c. maximum. Also see GA File No.FC5512 for generic, nonproprietary truss assembly.)



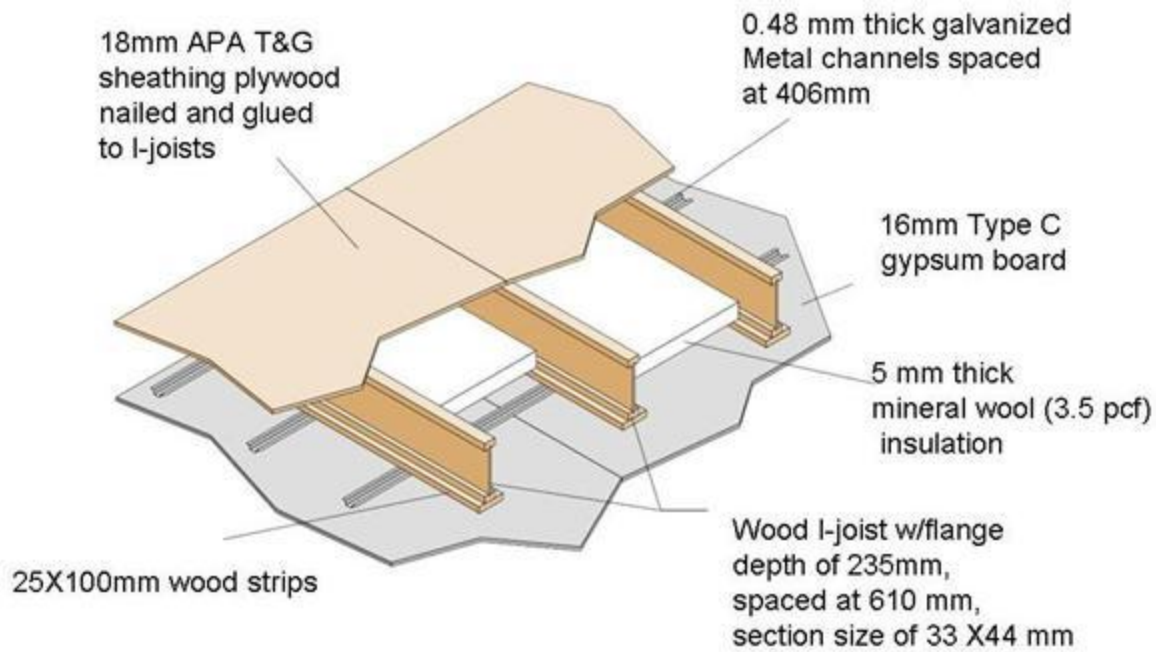
(d)

(More details can be referred to: AF&PA DCA 3 Assembly WIJ-1.1)



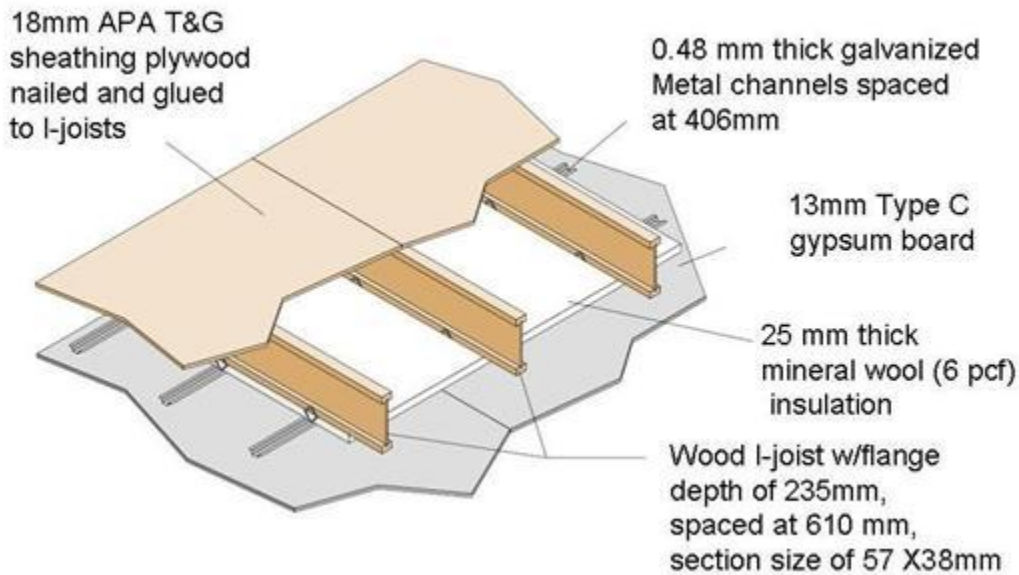
(e)

(More details can be referred to: AF&PA DCA 3, Assembly WIJ-1.2)



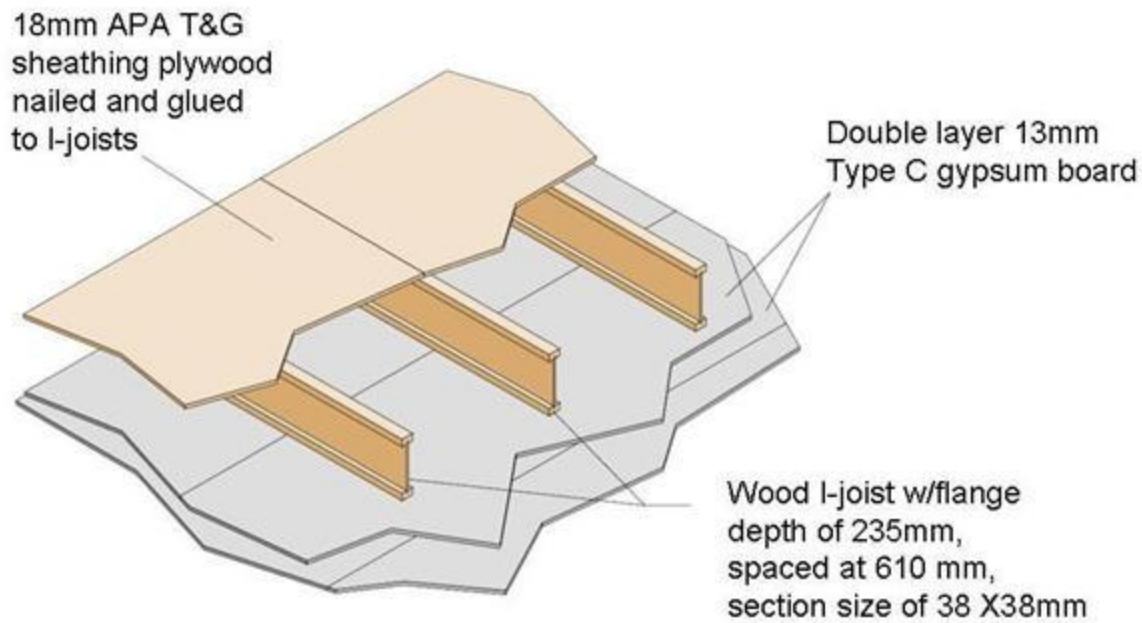
(f)

(More details can be referred to: 2003 IBC Table 720.1(3), Item No. 24-1.1)



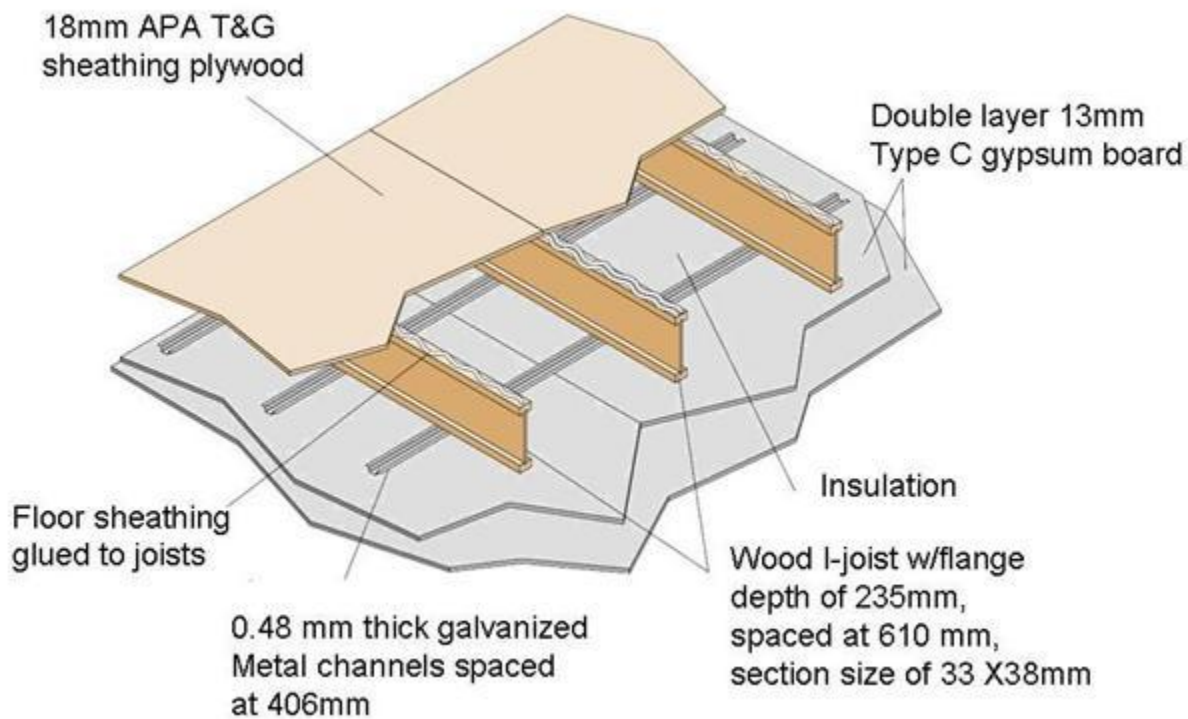
(g)

(More details can be referred to: AF&PA DCA 3, Assembly WIJ-1.4)



(h)

(More details can be referred to: AF&PA DCA 3, Assembly WIJ-1.5)



(i)

(More details can be referred to: AF&PA DCA 3, Assembly WIJ-1.6)

第九章 建築物之防火

9.1一般規定

木構造建築物之防火設計及施工，除應依建築技術規則建築設計施工編第三章規定外，其構造系統之防火設計依本章規定。

本章規定以外之其他火災安全防護措施（防火設計），應經中央主管建築機關認可。

【解說】

建築法規基於公共安全，對於一定使用用途、樓層數及規模大小之建築物要求須為防火構造建築物，此規定於建築技術規則設計施工編第六十九條，但工廠建築除依C類規定外，作業廠房樓地板面積，合計超過五十平方公尺者，其主要構造，均應以不燃材料建造。木構造建築物亦須符合此規定。

其他特殊構造系統之防火設計，適用建築技術規則確有困難者或尚無建築技術規則及中華民國國家標準適用者，可檢具申請書及性能規格評定書，向中央主管建築機關申請辦理建築新技術新工法新設備及新材料認可申請。

9.2木構造建築物防火規劃基本原則

木構造建築物為非防火構造者，應依下列事項，考量必要之防火措施：
防火區劃依規定設置，以各種構造及防火設備區隔達到規定之防火時效。

- (2) 內部裝修依相關內部裝修限制設計。
- (3) 外牆及屋頂，以使用不燃材料建造或覆蓋為原則。
- (4) 走廊、通道及出入口應符合逃生避難安全要求。
- (5) 防火間隔依規定留設，避免火災延燒至鄰棟建築物。

木構造建築物為防火構造者，除依上項規定外，並須考量主要構造之柱、樑、承重牆壁、樓地板及屋頂應具備規定之防火時效。

【解說】

木構造建築物依建築技術規則建築設計施工編規定，需考量必要之防火措施。木構造建築物防火安全設計之一般目的，為抑制火災引起的危險造成建築物本身與鄰棟建築物中的人員傷亡及財產損失。設計之考量，應以防止突發性火災的發生，及避免在火災發生後造成之人員傷亡與財產損失。木構造建築物防火規劃基本原則如下：

) 防火區劃設置規定如下：

木構造建築物屬防火構造者，依建築技術規則建築設計施工編第七十九條規定：

其總樓地板面積在一、五〇〇平方公尺以上者，應按每一、五〇〇平方公尺，以具有一小時以上防火時效之牆壁、防火門窗等防火設備與該處防火構造之樓地板區劃分隔。防火設備並應具有一小時以上之阻熱性。

前項應予區劃範圍內，如備有效自動滅火設備者，得免計算其有效範圍樓地板面積之二分之一。

防火區劃之牆壁，應突出建築物外牆面五十公分以上。但與其交接處之外牆面長度有九十公分以上，且該外牆構造具有與防火區劃之牆壁同等以上防火時效者，得免突出。

建築物外牆為帷幕牆者，其外牆面與防火區劃牆壁交接處之構造，仍應依前項之規定。

木構造建築物屬非防火構造者，依建築技術規則建築設計施工編第八十一條規定：其總樓地板面積應按每五〇〇平方公尺，以具有一小時以上防火時效之牆壁予以區劃分隔。

連棟式木構造建築物屬非防火構造，依建築技術規則建築設計施工編第八十四條規定：建築面積超過三〇〇平方公尺且屋頂為木造等可燃材料建造之屋架時，應在長度每十五公尺範圍內以具有一小時以上防火時效之牆壁區劃之，並應突出建築物外牆面五十公分以上。但與其交接處之外牆面長度有九十公分以上，且該外牆構造具有與防火區劃之牆壁同等以上防火時效者，得免突出。

) 木構造建築物之內部裝修材料，依建築技術規則建築設計施工編第八十八條規定。

) 木構造建築物屬非防火構造者，外牆及屋頂應使用不燃材料建造或覆蓋，依建築技術規則建築設計施工編第八十四條之一規定。但符合同編第一百十條之一第二項者，不在此限。

) 木構造建築物之走廊、通道及出入口，應依建築技術規則建築設計施工編第四章第一節出入口、走廊、樓梯之規定設計。

) 防火間隔設置規定如下：

木構造建築物屬防火構造者，其防火間隔應依建築技術規則建築設計施工編第一百十條規定。

木構造建築物屬非防火構造者，其防火間隔應依建築技術規則建築設計施工編第一百十條之一規定。

) 木構造建築物屬防火構造者其主要構造之柱、樑、承重牆壁、樓地板及屋頂之防火時效，依建築技術規則建築設計施工編第七十條規定。

9.3 木構造防火設計

(1) 梁柱構架

構材之最小斷面應依防火時效設計，於時效內燃燒之殘餘斷面須符合結構設計承載能力所需之最小斷

面尺寸規定。

不同材種集成材燃燒炭化深度依表9.3-1。但經中央主管機關認可者得依認可炭化深度辦理。

木構材接合部位以金屬扣件接合時，應使用適當之防火被覆材或將金屬扣件設置於規定防火時效之安全斷面內，以確保接合部之強度。

(2) 框組壁式

壁體、樓板及屋頂之主構材斷面應符合該系統相關設計及施工規範最小斷面尺寸之規定。

防火被覆用板材與填充材等應於防火時效內能維持壁體或樓板之防火性能。兩側採用厚度為15mm以上之耐燃一級石膏板材或厚度為12mm以上之耐燃一級矽酸鈣板之防火被覆用板材，與壁內填充材為厚度50mm以上密度 60kg/m^3 以上之岩棉所構成壁體，防火時效可認定為一小時。

防火被覆用板材之接縫處理，應於規定防火時效內能維持板材間接縫密合狀態外，並於接縫內側須設置能阻擋延燒之材料，以達設計之防火性能。

在牆壁、天花板、樓板及屋頂內中空部位等相互交接處，應設置阻擋延燒構造，避免火燄之竄燒蔓延。

(3) 原木層疊 (Log House System)

原木層疊系統除依梁柱構架系統考慮炭化率計算構材之安全斷面與接合部依梁柱構架系統規定處理外，其餘依相關設計及施工規範處理。

I型托樑、桁架及其他構造系統之防火設計，應經中央主管建築機關認可。

【解說】

(一) 梁柱構架系統防火設計

柱、梁、間柱、橫撐木等主構架所使用的構材，若未設置防火被覆時，應預估防火時效內構材之燃燒炭化深度，設計適當之斷面尺寸，使於規定防火時效內燃燒之殘餘斷面（即安全斷面）仍具備結構應有之承載能力。木材之炭化深度，係假設炭化率（火災發生時，從木材表面向內部燃燒炭化之速度）固定，將其乘上持續燃燒時間後求得。

國內實際以CNS12514「建築物構造部份之耐火試驗法」進行5種材種集成材炭化深度實驗，燃燒時間為30、60分鐘，實驗結果如表9.3-

1。所以根據實驗結果建議其他材種集成材1小時炭化深度設定為50mm以上，半小時為25mm以上，非集成材1小時炭化深度設定為60mm以上，半小時為30mm以上。若不依此數據設計，得採用經中央主管機關認可之實際實驗值設計。如非採炭化深度設計之火災安全防護措施，則應經中央主管機關認可。

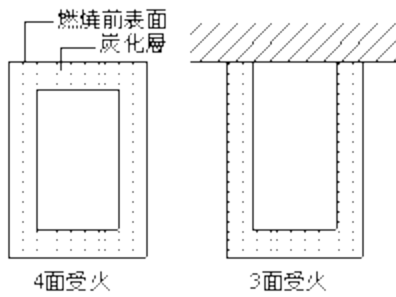


圖9.3-1 木材燃燒炭化深度示意圖 材三面受火1小時燃燒後情況

表9.3-1 不同材種集成材燃燒實驗炭化深度

材種		實驗時間	側邊炭化深度	底部炭化深度	備註
集成材	杉木	30分鐘	20.0 mm	23.5 mm	1.實驗方法採CNS12514「建築物構造部份之耐火試驗法」。 2.試體三面受火。 3. 30分鐘實驗：試體斷面尺寸260 mm x 140 mm 4. 60分鐘實驗：試體斷面尺寸260 mm x 203 mm
		60分鐘	43.4 mm	46.0 mm	
	柳杉	30分鐘	20.4 mm	21.5 mm	
		60分鐘	42.1 mm	46.8 mm	
	台灣杉	30分鐘	22.7 mm	23.5 mm	
		60分鐘	45.4 mm	49.0 mm	
	花旗松	30分鐘	19.2 mm	20.8 mm	
		60分鐘	37.4 mm	37.9 mm	
	南方松	30分鐘	17.0 mm	17.2 mm	
		60分鐘	32.8 mm	34.0 mm	
其他材種	30分鐘	25mm			
	60分鐘	50mm			
非集成材		30分鐘	30mm		
		60分鐘	60mm		

木構材接合部之設計應注意保護金屬扣件，避免火災持續燃燒期間因受火害之高溫影響，使金屬扣件強度衰減，導致接合功能之喪失。因此若使用金屬扣件接合時，應設置足夠厚度之防火被覆保護金屬扣件，或將接合金屬扣件設置在具防火時效之構材安全斷面內側。

(二) 框組壁式系統防火設計

壁式系統之壁體防火依下列規定設計：

框組壁式2×4工法之最小間柱斷面為38 mmx89 mm，牆間柱之中心距不得超過455mm。

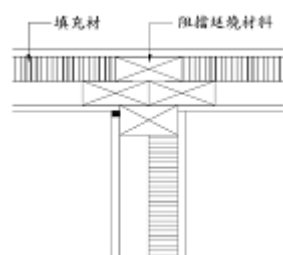
框組壁式2×6工法之最小間柱斷面為38 mmx140 mm，牆間柱之中心距不得超過610mm。

常見防火被覆用板材之種類及最小厚度，可採用厚度為15mm以上之耐燃一級石膏板材（符合CNS4458）或厚度為12mm以上之耐燃一級矽酸鈣板（符合CNS13777）等。

壁內填充材可採用密度60kg/m³以上之岩棉（符合CNS9659），最小厚度50mm。

依上述規定建造者可認定具有1小時防火時效。

當火災發生時，防火被覆用板材之接縫部份很容易成為防火上之弱點，因此除接縫處之密合要求之外，接縫內側得設置足夠斷面之木材等能阻擋延燒之材料，以達到充分之防火效能。



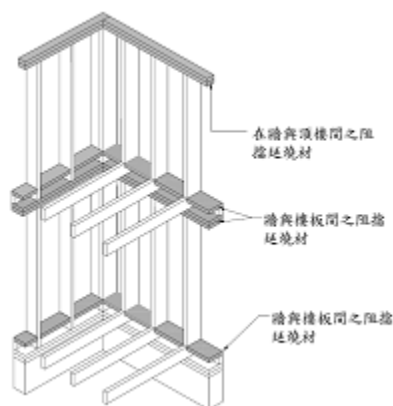
3防火被覆用板材接縫部份與阻擋延燒材料示意圖

範例（一）

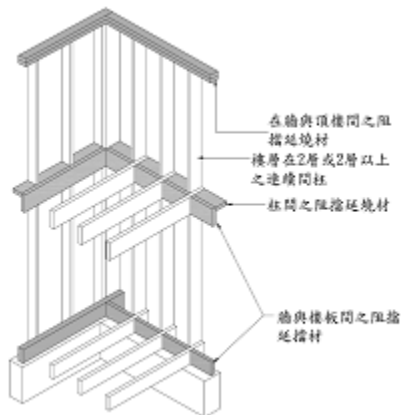
4防火被覆用板材接縫部份與阻擋延燒材料示意圖範

例（二）

牆壁、天花板、樓板及屋頂內中空部位因位於防火被覆板材之內側，一旦火舌進入後，很容易成為延燒之路徑，應在其內部做適當區劃，或於構造相互交接處設置阻擋延燒構造，使火舌即使進入後亦不會竄燒擴大至其他區劃或構造。所使用之阻擋延燒構造，應採用具有足夠斷面之木材或耐燃材料。



框組壁式系統延燒阻擋構造示意圖（一）



框組壁式系統延燒阻擋構造示意圖（二）

國外常用木構造牆壁、樓地板和屋頂系統可參考附錄六，於國內採用仍須經中央主管建築機關認可。

（三）原木層疊系統防火設計

原木層疊系統係指以原木、製材或其他類似木材在水平堆積成牆壁之建築物的工法。

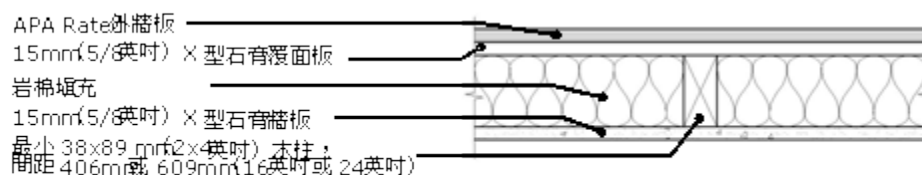
結構構材之斷面防火設計與前述梁柱系統相同，即構材未設置防火被覆材時，應預估防火時效內構材之燃燒炭化深度，設計適當之斷面尺寸，使燃燒後之殘餘斷面（即安全斷面）仍具備應有之承載能力，並確認該安全斷面所承受之長期應力不超過短期容許應力，1小時燃燒炭化深度設定為60mm以上。

附錄六 國外常用木構造牆壁、樓地板和屋頂系統

木構造牆壁、樓地板和屋頂系統，美國International Code Council出版之2006 International Building Code第7章第720節表720.1 (2) 及表720.1 (3) 列有相關規定，需再經檢討以符合我國法令規定，方可於我國使用，如欲參照所列系統設計施工，應經中央主管建築機關認可。

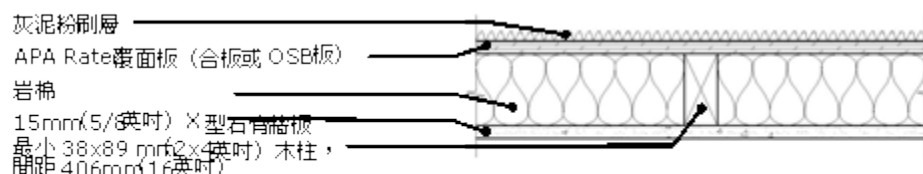
依據美國APA「Fire Rated Systems - Design/Construction Guide」經防火時效實驗驗證通過的承重牆壁、樓板及天花板構造，舉例如下，採用仍須經中央主管建築機關認可：

附圖六-1 具1小時防火時效之承重外牆構造



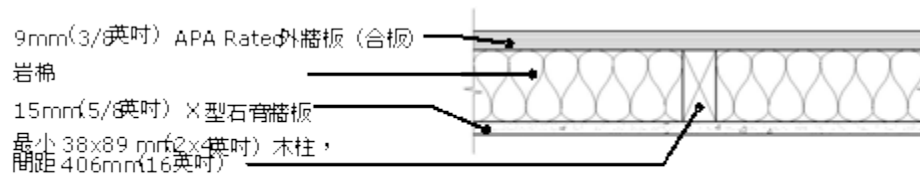
(a)

(參考：1997 Union Building Code Tab. No. 7-B, 1999 Standard Building Code sec. 701.5.2)



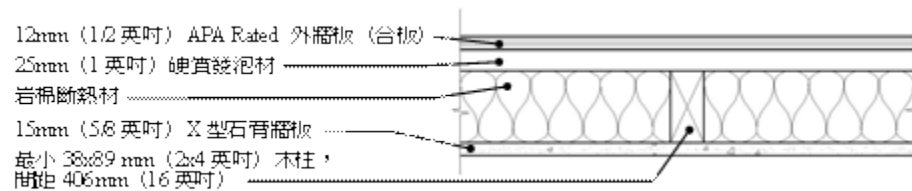
(b)

(參考：2003 International Building Code Table 720.1(2), sec. 2.2.2 of ICC Evaluation Service Inc.,



(c)

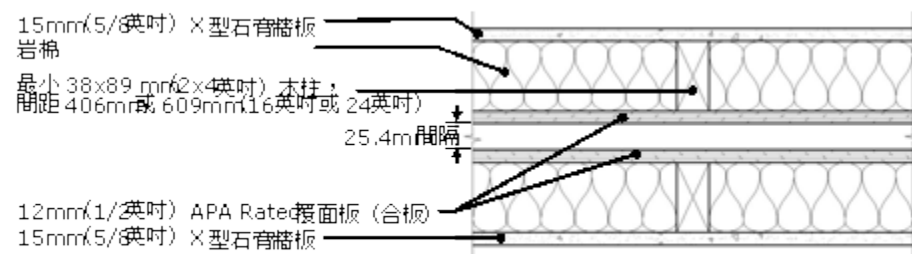
(參考：Section 721-6 of International Residential Code, Section 709.6.2.4 of the International Building Code, Section 6.2 of Guidelines for Determining Fire Resistance Ratings of Building Building Elements (BOCA International, Inc./1994/))



(d)

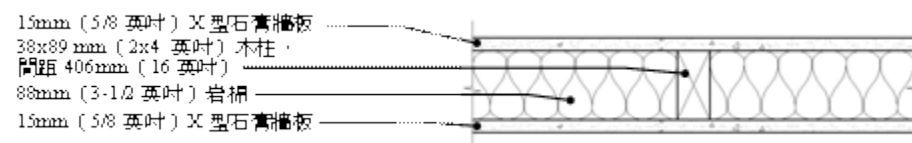
(參考：UL design No. U326, U330 (如圖) , U335 (如圖) , Underwriters Laboratory Inc. (U.L.) Fire Resistance Directory)

附圖六-2 具1小時防火時效之室內承重牆

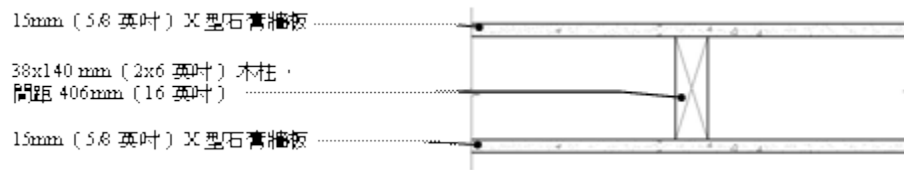


(a)

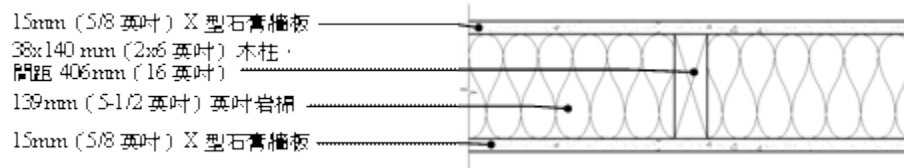
(參考：UL design No. U339, U341 (如圖) Underwriters Laboratory Inc. (U.L.) Fire Resistance Directory)



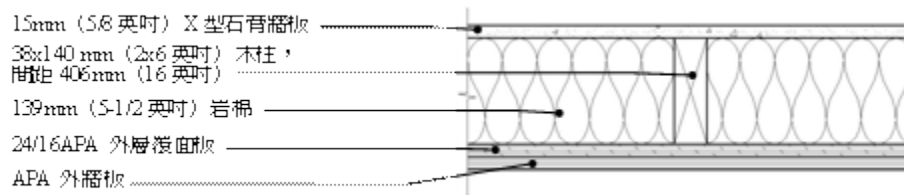
(b)



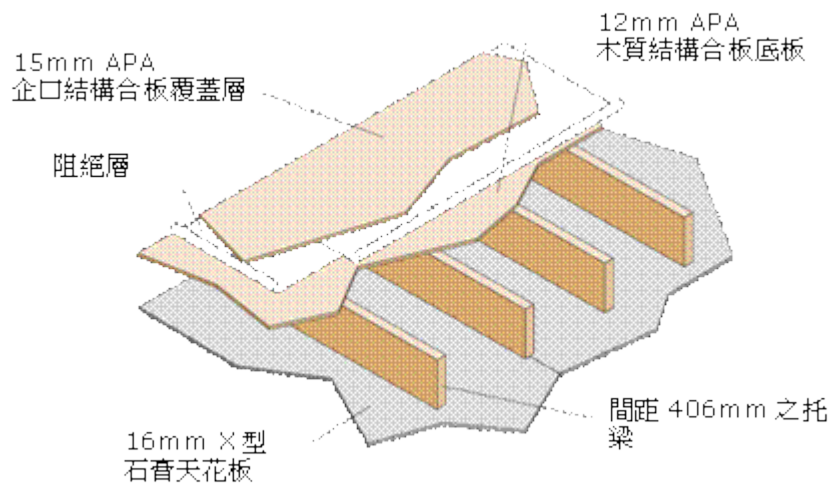
(c)



(d)



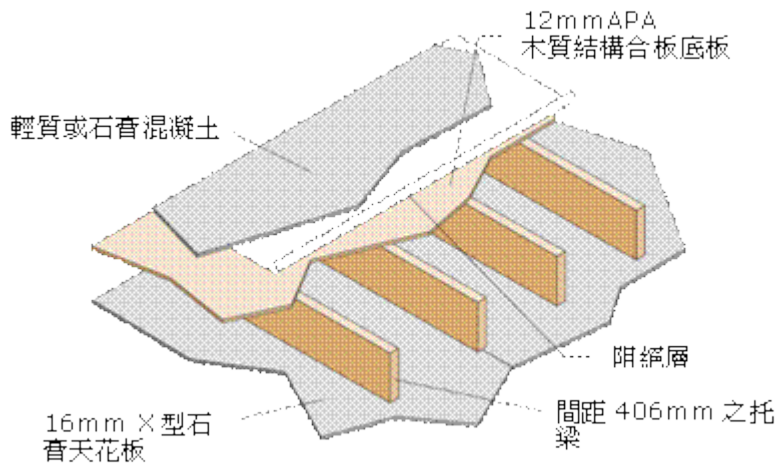
(e)



附圖六-3

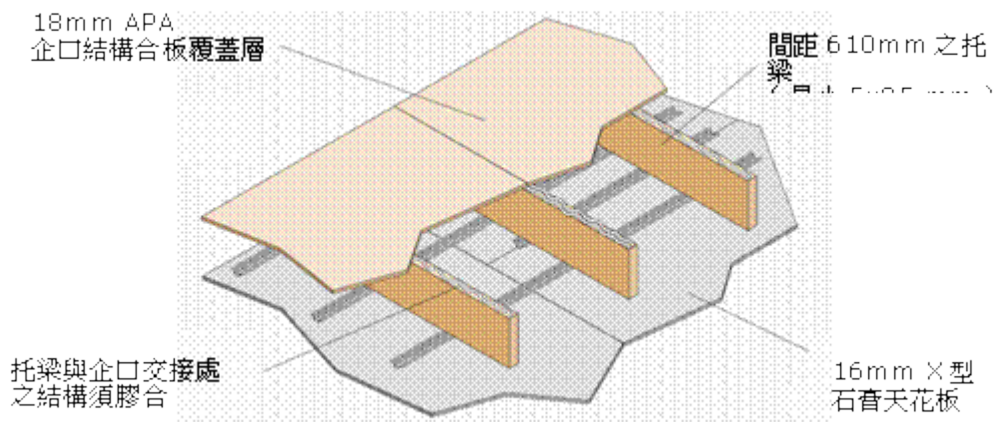
具1小時防火時效之樓板及天花板構造

(a)



(b)

(參考：Underwriters Laboratory U.L. Design Nos. L001, L003, L004, L005, L006, L201, L202, L206, L209, L210, L211 (2 hr), L212, L501, L502, L503, L505 (2 hr), L511 (2 hr), L512, L514, L515, L516, L519, L522, L523, L525, L526, L533, L535, L536 (2 hr), L537, L541 (2 hr) and L545. Also see U.L. Design Nos. L524 with steel joists spaced 24" o.c., L521 with wood trusses spaced 24" o.c. and L549 with steel trusses spaced 48" o.c.)

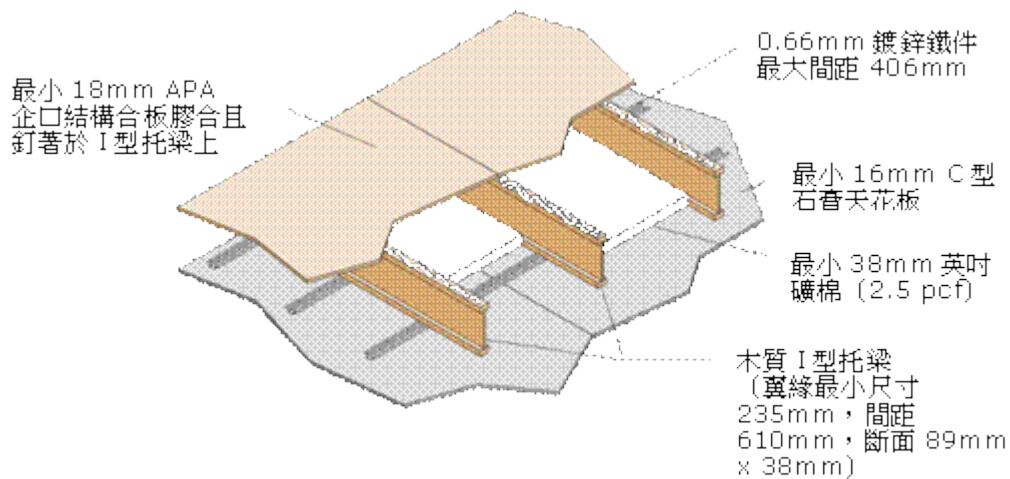


(c)

(參考 : Underwriters Laboratory U.L. Design No. L513. Also see U.L. Design Nos. L504 for stressed-skin panel (5/8" APA RATED STURD-I-FLOOR or SHEATHING plywood with joists spaced 12" o.c.); L507 for 5/8" APA RATED STURD-I- FLOOR plywood with joists spaced 16" o.c.; L508 for 1-1/8" APA RATED STURD-I-FLOOR plywood with joists spaced 48" o.c.; and L539, L540 with joists spaced 16" or 24" o.c. and separate ceiling assembly (for modular housing units). Also see U.L. Design Nos. L524 and L543 with steel joists spaced 19.2" or 24" o.c. (L543 with separate ceiling assembly).)

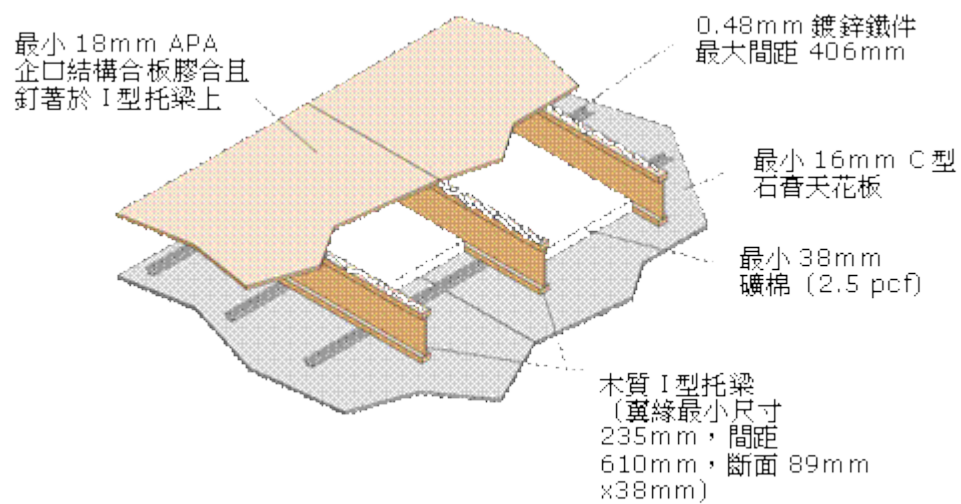
單層I型托梁或桁架樓板系統

(參考 : U.L. Design Nos. L528, L529, L534, L542 and L548 with trusses or L544 with I-joists spaced 24" o.c. maximum. Also see GA File No.FC5512 for generic, nonproprietary truss assembly.)



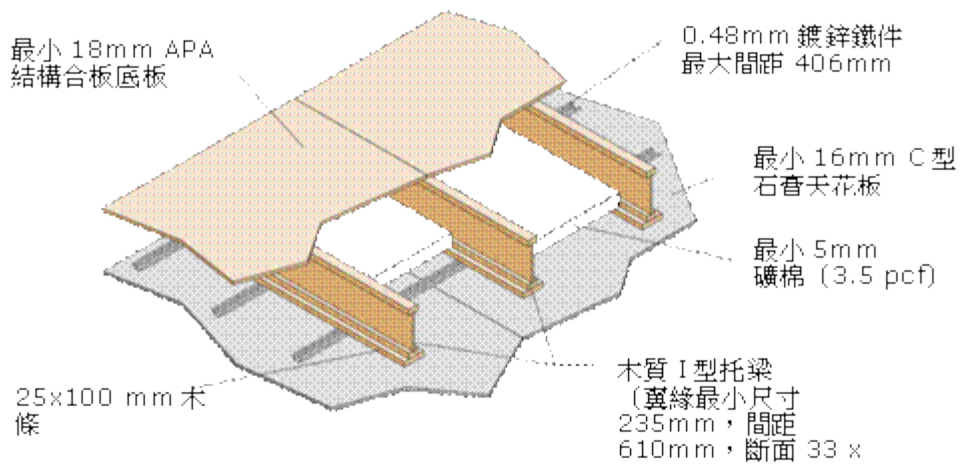
(d)

(更多細節參考：AF&PA DCA 3 Assembly WIJ-1.1)



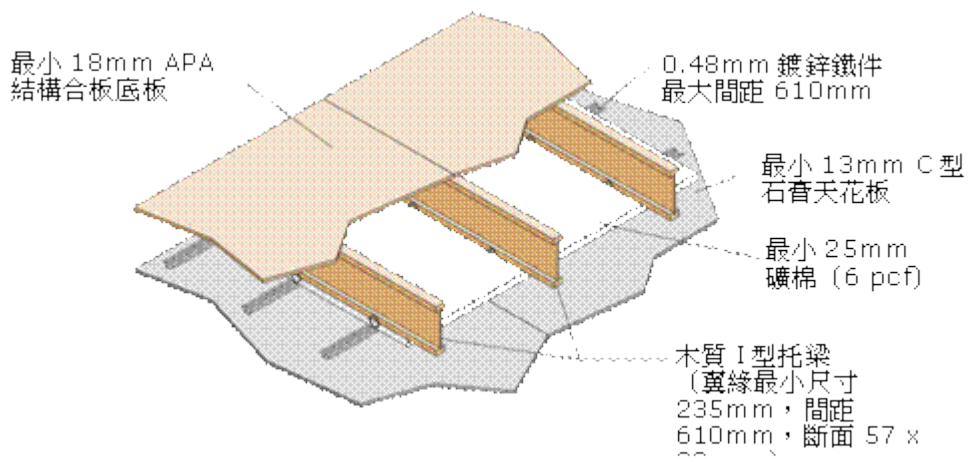
(e)

(更多細節參考：AF&PA DCA 3, Assembly WIJ-1.2)



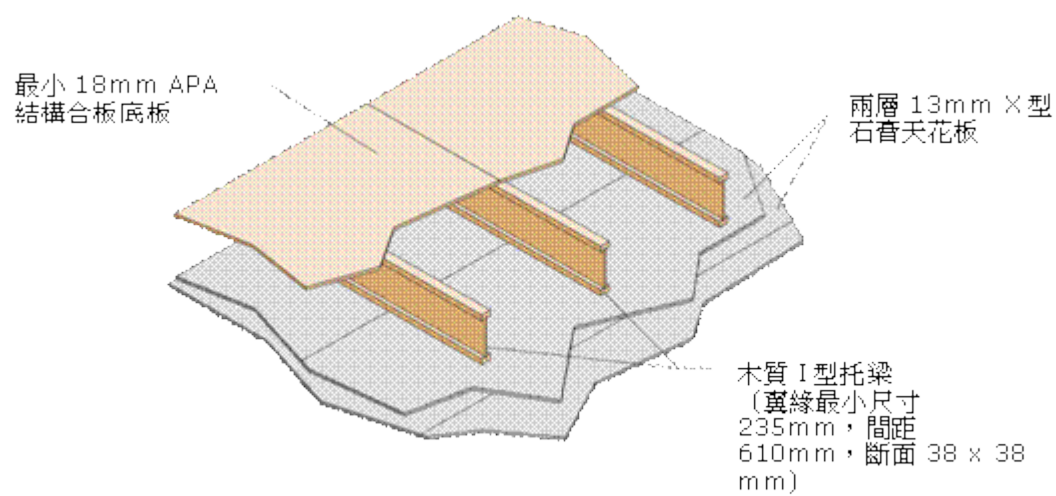
(f)

(更多細節參考：2003 IBC Table 720.1(3), Item No. 24-1.1)



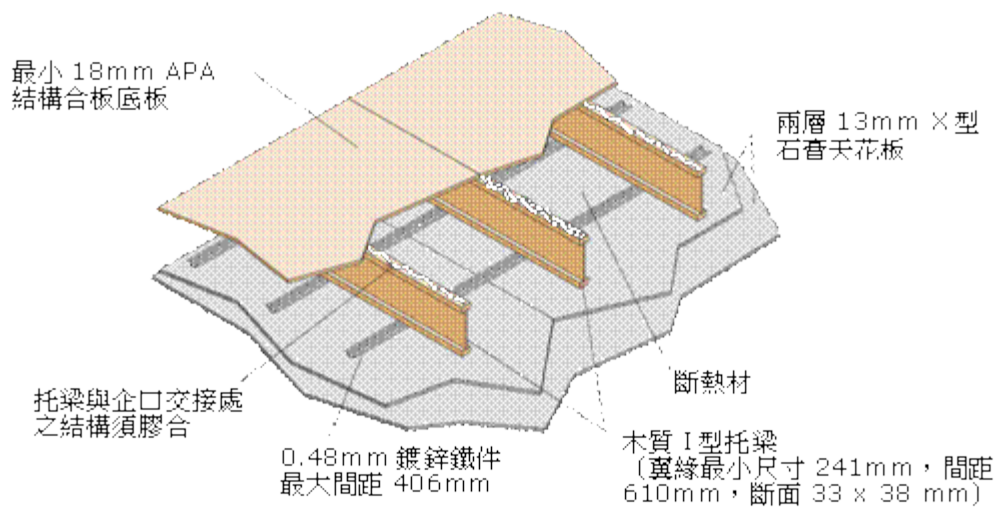
(g)

(更多細節參考：AF&PA DCA 3, Assembly WIJ-1.4)



(h)

(更多細節參考：AF&PA DCA 3, Assembly WIJ-1.5)



(i)

(更多細節參考：AF&PA DCA 3, Assembly WIJ-1.6)